DATA PROCESSING DIGEST

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Management Decision-making Techniques

NEW BOOKS ON MANAGEMENT SCIENCE

In the past two years, a number of books have appeared on various aspects of the scientific approach to management problems and operations research. All of these books are of high quality, written by leaders in the field, and most are written in a manner as easy to follow as possible. Rather than review each as a separate entity, DPD has organized the books into a reading program. This program is designed for management personnel who wish to be able to apply the techniques of management science to their own problems. It may be used by students, also, who wish to pursue a study program in addition to their course work.

CONTENTS

BACKGROUND

No matter how simply the various management techniques are explained, constant use of calculus and statistics must be made. If you cannot use these mathematical techniques easily, we suggest a review, using:

Calculus Made Easy, Thompson, Macmillan, 2nd ed., 1953,
Facts from Figures, Moroney, Penguin Books, 3rd ed., 1956,

or the textbooks with which you are familiar.

Supplemental reading. For those who wish further background in the basic mathematical techniques used in management science (perhaps studying these concurrently with the program below), these new books are available:

Introduction to Finite Mathematics, Kemeny, Snell and Thompson, Prentice Hall, 1957,
An Introduction to Combinatorial Analysis, Wiley, 1958,
A Survey of Modern Algebra, Birkhoff and MacLane, Macmillan, 1953.

BASIC TEXT

The basic work in operations research, which should be read in its entirety as soon as the requisite mathematical background is obtained, is still:

Introduction to Operation Research, Churchman, Ackoff, Arnoff, Wiley, 1957.

This book is the best source of material on the general nature and application of scientific techniques in business. It also covers the basic techniques which are new to the field (see DPD review, March 1957, page 8).

SELECTED READINGS

After the basic background program outlined above, there are texts which cover specific fields. If these are studied as listed below over a period of several years, an excellent background in the entire field can be obtained. If you have specific problems to solve, the sequence in which these texts are studied may, of course, be altered.

1 ON DECISION PROCESSES: Design for Decision, Bross, Macmillan, 1953. This is basic, since decision problems are the subject of management science.

2 ON PROGRAMING (The arrangement of work in a plant--not computer programing): Scientific Programming in Business and Industry, Vazsonyi, Wiley, 1958. Useful, programing techniques are of proved value.

3 ON PRODUCTION MANAGEMENT TECHNIQUES: Analysis for Production Management, Bowman and Fetter, Irwin, 1957. This is a good text on the undergraduate level. Queues, Inventories, and Maintenance, Morse, Wiley, 1958: Contains discussions of the theory behind useful, proven techniques.

Supplemental reading. For deeper studies in this area, these books may be followed by:

Production Planning and Inventory Control, Magee, McGraw-Hill, 1958. Describes practical techniques and approaches.

Studies in the Mathematical Theory of Inventory and Production, Arrow, Karlin and Scarf, Stanford Univ. Press, 1958. Highly sophisticated.

4 ON BASIC ECONOMICS: Economics; An Introductory Analysis, Samuelson, 3rd ed., McGraw-Hill, 1955.

Supplemental reading. For a rather modern, control-system approach to economics, read: The Mechanism of Economic Systems, Tustin, Harvard Univ. Press, 1953. (See below for background on control systems.)

5 ON COMMUNICATION (INFORMATION THEORY): On Human Communication, Cherry, Wiley, 1957.

6 OTHER TEXTS ON THE SYSTEMS APPROACH AND RELATED TOPICS:

Principles of Servomechanisms, Brown and Campbell, Wiley, 1948. This is a good review of control system theory.

Systems Engineering, Goode and Machol, McGraw-Hill, 1957.

Games and Decisions, Luce and Raiffa, Wiley, 1958.

PERIODICALS

The key periodicals in this field, which provide a continuing education, are:

Operations Research, Mt. Royal and Guilford Avenues, Baltimore 2, Md.

Management Science, 250 North Street, White Plains, N. Y.

For a classified listing of previous periodical articles, see: A Comprehensive Bibliography on Operations Research, Case Institute of Technology and Operations Research Society of America, Wiley, 1958.

Many of the texts listed overlap to some extent; but this duplication is desirable, in that different authors will give a different approach to the same techniques. Most of the books have good examples which should be followed through, if you wish to really grasp the technique. Bibliographies are included in many of these books (see especially the bibliography in the basic text--Churchman, et al), which form a guide to further reading in subjects of special interest to you.

NEW FILMSTRIP

"Operations Research: A Practical Introduction for Management" is a new three-part sound film strip produced by the American Management Association for a basic introduction to the principles of

operations research. Part one underscores the purpose of the series in a general way, and prepares the novice for parts two and three which give some excellent examples of OR techniques applied to production problems. This purpose is "to state clearly and effectively the basic philosophy of Operations Research as a way of thinking about management problems....and to stress that OR does not propose final, fixed solutions, but rather presents the executive with a rational basis for choosing among alternative solutions in situations which may be changing." Also, the films stress frequently that OR does not "supplant the executive's prime function of framing policy and making decisions."

In part two, the principles and techniques of OR are applied to two problems of a typical manufacturing company. One problem concerns the improvement of traffic schedules for shipping 15 products from three plants to nine warehouses, and demonstrates the use of linear programing. In the second problem, decisions on the construction of new loading docks are made with the help of queuing theory and the Monte Carlo technique. Both problems are well presented, the second one being especially good. In part three, the same company's production problems are considered. The problem is to balance production at each plant with supply and demand for each product at each warehouse; an example of a complete systems problem is included to show the scope of operations research solutions. The film does not go into details of the analysis and computation involved, but the problem presented could be solved by using "the transportation method" and "the techniques of inventory theory."

Conclusions reached include: OR needs a clear definition of management objectives, needs time and can seldom help with "rush" decisions and requires a team of trained personnel. If properly used OR indicates "the consequences of possible decisions" to management.

Price of the film is $85 for AMA members, $110 for non-members. For information, write to: American Management Association, Visual Education Department, 1515 Broadway, New York 36, New York

OPERATIONS RESEARCH AND THE ACCOUNTANT

Arthur A. Brown, Arthur D. Little, Inc., Cambridge, Mass.
N.A.A. BULLETIN, July 1958, Section 2; pages 3-10.

Operations research makes use of "models." A model is described here as "a mental image of a real object or process, simplified and abstracted by suppression of irrelevant details and put into communicable form." The model allows its users to see how the process would operate under different conditions, and inspires the development of new concepts. An illustration is given of a model

designed for use in a production process, and formulas are developed which may be used for forecasting the interaction of inventory, sales, and production under varying circumstances.

"Models" are defined and illustrated

The danger in using cost figures unrealistically to determine policy is then brought out, using two vivid illustrations to demonstrate. In one illustration, a packaging plant which packaged a product seasonally, but brought in containers on a uniform schedule, wished to operate the labor force on a steady schedule throughout the year. The manager was prevented from levelling the labor peaks because the costing of packaged inventory was set up to include a large overhead, whereas the unpackaged product and containers did not carry this cost. In this case, a cost derived for one purpose was accepted for another without question.

Some ways in which the operations researcher can help the accountant are given. These include the applications of statistical theory to accounting (for example, sampling techniques), the development of time and cost standards, and the entire area of electronic data processing. In this last area, the OR expert can assist in the necessary redesign of the business, based on a proper model of the business. The redesign should "take advantage of the latest developments in the theory of inventory control and production scheduling, and should be flexible enough to permit research on sales, costs, and profits to be done economically."

OPERATIONS RESEARCH, RANDOM SAMPLING AND THE INTERNAL AUDITOR

Richard A. Byerly, Greyhound Corporation
THE INTERNAL AUDITOR, June 1958; pages 51-62.

The article contains a simplified and quite lucid explanation of random sampling, using as an example, the sampling of 10,000 invoices for errors in extensions. The difference between judgment sampling and scientific sampling is pointed out. In judgment sampling, there is an aura of doubt about the result, but in scientific sampling, the boundaries of acceptability are determined before the sampling takes place. Risk, a factor in both types of sampling, is acknowledged and planned for in the scientific sampling method. In the example used, the parameters are suggested as follows:

"I will accept these invoices as accurate if the population error is not greater than 2 per cent. I want to be assured that 95 per cent of the time, I will be within 10 percent of the true value of this 2 per cent factor."

Some examples of the use of sampling theory are then given. The article points out that a computer is not a necessary adjunct to sampling theory, and that, in fact, sometimes sampling techniques may be more efficient than 100 per cent checking by means of the computer. On the other hand, some sampling problems may use computer programing to advantage.

General Information

— AND HOW TO AVOID THEM

D. T. Caminer
THE COMPUTER JOURNAL, April 1958; pages 11-14.

Some of the "shortcomings" of American EDP programs are also apparent in England. "Computers have been installed without their programs ready...[In]one installation, the very able team... have said that they were getting little out of it beyond what previously could be obtained from their punched card installation."

"Getting full-scale, realistic clerical work into regular operation on a computer is not easy." But "having gained a proper respect for the difficulties, a well-found team can master them."

Recognize electronics as a new systems situation

Perhaps it is the representation of the work of preparing for a computer installation as a simple extension of conventional methods work that is at the root of much of the trouble both in the States and here. The situation is perhaps even worse here ((England)) where there are very few senior personnel engaged in long-range office methods work. Some methods men have recognized that it was a new situation with which they had to deal. They would then consult expert assistance; which "can only mean sustained assistance at the outset from people with first-hand experience of getting large-scale commercial work operating on a digital computer."

The factors in installing a computer which make expert guidance necessary are these:

1. To achieve its potential an Automatic Office must tackle a whole job.

2. It must meet the productive requirements of the job.

3. It must aim to do the job automatically.

"To find the middle course between what is initially impractical and what is insufficiently significant must necessarily be a prime purpose [of]the potential purchaser...."

BUREAU OF TECHNICAL INFORMATION

The Iota Services Ltd. of England puts out a Computers edition in their Bureau of Technical Information Series.

Titles of articles are given in their original language, and annotated in English. Both technical and general subjects are covered, including programing, applications, equipment, conferences, education, new books, patents, and trade literature. The listing includes analog as well as digital equipment. For information, write to Iota Services, Ltd., 38 Farringdon Street, London E.C.4, England.

SPECIAL REPORT: COMPUTERS

BUSINESS WEEK, June 21, 1958; pages 68-92.

False starts and misconceptions have hampered efficient use of computers in business and industry. But businessmen are learning what computers can do, and gradually the picture of how a computer affects corporation structure is taking shape. This report gives a general view of the present situation as well as the future potential.

NAVY'S "EDP" PRINCIPLES AND OBJECTIVES

NAVY MANAGEMENT REVIEW, June 1958; pages 8-10.

Part III of this series ((see DPD: June 1958, pg. 2)) describes another of the EDP principles, that of "management by exception." Four areas of decision-making which may be considered in the "exception categories" are described. These are: "the difficult case, the rare case, the action case, the significant case." Unless the EDP system is designed to take full advantage of the computer's ability to make decisions, based on clear-cut programed principles established by management, "there exists little likelihood that an electronic data processing system is being utilized to its best advantage."

NOMA GLOSSARY OF AUTOMATION TERMS

The National Office Management Association has reprinted in a convenient bound form, the glossary contained in the rather cumbersome "Second Survey of Domestic Electronic Digital Computing Systems," published by the Ballistic Research Laboratory. ((See DPD, January 1958, page 9.))

The glossary is limited to technical terminology of computer operations and programing. However, it will be a welcome addition to the management library on EDP. It may be purchased from NOMA for $2.00, from their headquarters at Willow Grove, Pennsylvania.

APPROACH TO COMPUTER APPLICATIONS

G. Cushing, The National Cash Register Co. Ltd.
THE ACCOUNTANT, May 24, 1958; pages 622-625.

Readers in Great Britain who are not fully acquainted with the use of electronic data processing systems in business may find this article a good introduction. Integrated data processing, the preliminary study period, the integrated approach, and questions of management organization are covered.

CPR'S FIRST YEAR WITH A COMPUTER

Dr. John Rollit, Canadian Pacific Railway Company
OFFICE EQUIPMENT NEWS, May 1958; pages 32-35.

The Canadian Pacific Railway is presently running 88 programs on its IBM 705. An IBM 705, Model III is on order to replace the present model. The company not only talked over its EDP plans from the beginning with the Brotherhood (railroad union) but has included a provision to furnish the Brotherhood with punch cards on union dues deductions for their internal processing purposes.

COOPERATIVE AUTOMATION FOR SMALLER BANKS

BANKING, June 1958; pages 58-60, 130-132.

A plan for the cooperative use of electronic equipment is described. This is the plan of the Adair Company of Detroit, which proposes a centralized computer linked to the cooperating banks (mixed in size and type) by telephone or teletype lines, or by a delivery system. The center would be maintained and operated by the Adair Company, and the latter would also train bank personnel and machine operators. The center's policy would be set by a board of governors made up of representatives from the cooperating institutions and the Adair Company. The center would offer three types of service: immediate processing, batch processing, and delayed processing, and it would perform special tabulations for individual members where they do not interfere with normal operations. Immediate processing would be possible when the teller's window machine is connected with the central computer. Batch processing would be done with teller's machine transactions recorded on cards or paper tape.

Applications

INCENTIVE PAY GOES ON COMPUTER

COMPUTING NEWS, June 15, 1958; pages 3-6.

The Steel Division of the Ford Motor Company computes incentive pay from byproduct punch cards of scheduling operations. The system is maintained by the Systems department. All program functions have been cataloged and numbered so that all programs follow a similar pattern and each program starts with the same console setting. The purpose of this standardization is to simplify the machine operation so that any tab operator can take over machine operation. An IBM 650 is used.

Seventeen thousand time and cost standards have been set up to cover each grade of steel and each size in each operation. These standards represent the amount of time needed to produce one ton of any particular kind. A master file of orders is exploded into all operations required to make the finished product, and time standards are then applied to the individual operations. New orders are entered once a week, requiring one hour of computer time. A step-by-step description of the computer passes is given, along with a list of uses for the order file.

PRODUCTION PARTS SCHEDULING ON THE FILE COMPUTER

COMPUTING NEWS, June 1, 1958; pages 13-16.

The Ford Division at Dearborn uses a Univac File Computer for production parts scheduling on 11,000 different kinds of parts and assemblies, from 804 suppliers. The File Computer was chosen because it allowed the former punched card system to be continued. Anticipated programs to be placed on the computer include preparation of critical and behind-schedule reports, disposal of discontinued production parts, and pin-point control of major parts currently used in production.

MICHIGAN STATE HIGHWAY DEPARTMENT

COMPUTING NEWS, May 15, 1958; pages 3, 4.

The Michigan State Highway Department is using a Bendix G-15D to do earthwork computations at a speed of about one mile of highway per hour, at an estimated cost of about $42 per mile. This is estimated to be about 30 times as fast as a man can do the computing manually, at a cost of about $105 per mile.

ENGINEERS BUY TIME AND SPEED WITH AN ELECTRONIC COMPUTER

CONTRACTORS AND ENGINEERS, June 1958; pages 128-131.

The engineering firm of King & Gavaris in New York is using an LGP 30 computer to save pile-driving contractors time and money on construction sites. When piles are driven away from their design location, the true loadings must be recalculated. The engineering firm developed a computer program to calculate these true loadings in nearly one-tenth the manual time required. This was a saving in time and money for the contractor who must have equipment and time ready to drive more piles to carry the new load requirements.

AUTOMATION COMES TO CANADIAN BANK

C. E. Ritchie, Bank of Nova Scotia, Toronto, Canada
OFFICE EQUIPMENT NEWS, June 1958; pages 26-29.

The Toronto Branch of the Bank of Nova Scotia has installed three NCR Post-tronics to process its checking accounts. It chose the alphanumeric account numbering system, using a six digit number for each account. A gap of 256 is left between accounts in the original numbering procedure, and an emergency gap is left between every 5 or 10 accounts. New accounts will be inserted in their alphabetic order in the gaps. Related accounts (where one customer has two different types of accounts) are separated by only 7 spaces. The bank has found that sorting by number is easier for inexperienced help than sorting by signature. Cancelled check sorting has been set up by number also.

Equipment

TYPATAPE RECORDER AND TYPATAPE-TO-CARD CONVERTER

OFFICE AUTOMATION Supplement No. 33, pages 78c-78d.

The Typatape ((See DPD: July 1957, pg 12)) is a completely mechanical tape recorder which may be linked to any office machine, mechanical or electrical, to produce a coded tape as a by-product of typed or keyed information. The Typatape-to-Card Converter converts the coded tape information onto punched cards. The Typatape Recorder may be used where no electrical connections are to be had, or may be used with a portable adding machine set-up.

PRINTERS

OFFICE AUTOMATION Supplement No. 33, page 179b.

Burroughs Corporation has developed a high speed printing technique called Electrographic Recording. A 5 x 7 matrix is formed by 35 wires which are charged according to the alphanumeric pattern. The charge is transferred to paper passing over the bank of parallel matrix heads. If the image is to be made permanently visible, it is coated with powdered ink and fixed thermally. The only moving part is the paper feed.

General Electric Company has a printer using a technique the company calls ferromagnetography. A latent magnetic image is produced on a permanently magnetizable surface. Charged particles are placed on the image, and this surface is then pressed against a specially prepared heated paper to produce the final image.

RECENT WORK ON READING MACHINES FOR DATA PROCESSING

Daniel Broido, LEO Computers Ltd., London, England
AUTOMATION PROGRESS, May 1958; pages 183-185.

The problems of character recognition of input data are discussed, and several methods are described. These include mask sensing, pulse sensing, positional coding, and others. The discussion is technical, and does not suggest the application of the equipment in an information system.

ADVANTAGES OF THE NATIONAL 304 ELECTRONIC DATA PROCESSING SYSTEM

THE INTERPRETER, June 1958

The monthly publication of the Insurance Accounting and Statistical Association includes a description of the NCR 304. The machine is designed primarily for business uses, although it provides for the mathematical techniques of management decision-making. Ease of programing and flexibility in combining components are two of its characteristics. For information on obtaining a copy of this issue of The Interpreter, write to: T. D. Kennedy, Employers Reinsurance Corporation, Kansas City, Missouri.

ELECTRONIC BALLOT TABULATOR

WESTERN ELECTRONIC NEWS, June 1958; page 48.

SCAN, an electronic ballot tabulator, has been designed by the Southern California Aircraft Corporation of Ontario, California. Paper ballots, marked by voters, may be placed in SCAN's feeder, and read by its photoelectric eye at the rate of 100,000 votes per hour.

Programing

THE RECRUITING, SELECTING AND TRAINING OF PROGRAMMERS

T. C. Rowan, System Development Corporation, Santa Monica, California
DATAMATION, June 1958; pages 16-18.

Twenty-four weeks of training for SAGE-men

System Development Corporation provides the personnel for the SAGE system of Air Defense. It has had to find, and train, about 800 programers in the past year and a half. Recruiting was nation-wide, and initiated through low pressure newspaper ads which indicated that minimum requirements were mathematics through calculus and willingness to relocate. Selection was a three-part process. First a personal interview provided the candidate with an introduction to the company and to the position. Second, a psychological test battery was given the candidate. If he passed the tests, another interview was held, during which the recruiter looked for interest in programing and the computer field. This interview usually lasted about two and a half hours per person.

An extensive training course has been designed for the recruits. This consists of a basic eight-week course in the SAGE computer and system, followed by sixteen weeks of advanced training. Professional trainers have been assigned to this task, selected because they like to teach and, preferably, have experience in teaching. Good teaching methods are stressed. A special text book has been written for the courses. In the basic course, classes are held to twenty, with two instructors per class. In the advanced class, the ratio is five students to each instructor.

The psychological test battery used in the selection process includes the Thurstone Primary Mental Abilities Test and the Thurstone Temperament Schedule, with subtests including the Verbal Meaning, Reasoning, Space, and Emotional Stability tests. Validation studies have indicated that results of these tests could be considered reliable.

TRAINING THE COMPUTER PROGRAMER

COMPUTING NEWS, July 1, 1958; pages 13-15.

A serious subject is written up in typical light style, but with plenty of substance. The magazine's publisher gives some points in programer training as a result of his own experience as a programer trainer. Seven suggestions are contained in this short article, as follows:

Pressure-style teaching

1. Introduce the novice to the concepts of programing through use of a small desk-size electronic computer.
2. Give him more to learn than he is able to learn at one time.
3. Use the "bootstrap" method, that is, give him at least one more task than he can complete at one given time.
4. Assign him to an "old hand," but don't let him become just a Man Friday to the pro.
5. Let him plunge into a job on his own, making mistakes as he will, and learning from them.
6. Let him do all the jobs, so he will become versatile, and not just a specialist in one thing.
7. Maintain day-to-day morale with encouragement or discipline as needed.

While the novice may think this system sounds somewhat drastic, the author believes he gets the best programers by separating "the sheep from the goats early in the game. The goats are soon overwhelmed, resign, and become stock and bond salesmen...."

BIG COMPUTERS SOLVE PACKAGED PROBLEMS...ECONOMICALLY

PRODUCT ENGINEERING, June 2, 1958; pages 28, 29.

Service bureaus can offer help in many situations. In one-shot problems or infrequently-recurring problems, a service bureau can provide the customer with low-cost fast and accurate computing. Service bureaus are also a help to companies with large computer installations when the work load is too large, or when the company's own computer has a future delivery date. Sometimes service bureau customers agree to rent out or lend their programs to others with similar needs. Service bureaus are operated by computer manufacturers, by consultants, and by some government agencies.

RANDOMIZING THE FEDERAL STOCK NUMBERS FOR DESK STORAGE ON 305

COMPUTING NEWS, July 15, 1958; pages 3-5.

A method is given for converting 11-digit Federal stock numbers to Ramac 305 file addresses, using an internally programed formula to randomize the stock numbers.

Comment

MACHINE LINGUISTICS (ML)

In June, four members of the staff at RAND Corporation, Santa Monica, California, presented related papers on the subject. "Machine Translation Research at RAND Corporation," at a Los Angeles meeting. The papers pointed out the rapid developments that are taking place in the general field of machine linguistics (ML). A brief review of articles abstracted in DPD during the first six months of 1958 certainly substantiates this point.

Words are rapidly succumbing to electronic processing

As pointed out by the RAND men, there are four sub-classes within the field of ML. We would like to add at least one more of our own. Published articles indicate that progress is being made in all of them.

Machine indexing (MI) is concerned with converting a natural language (say, Ancient Hebrew) to a numerically-coded language and then sorting, generally to aid study by scholars. An article titled "705 Indexes Dead Sea Scrolls"[1] describes the use of an IBM 705 for indexing the words, so that each word could be studied in all of its contexts. Also, in tests, the 705 could replace correctly as many as five consecutive words to aid in filling in multilated sections.

The next level of machine linguistics is concerned with machine abstracts (MA) wherein text in a natural language is converted to a shortened text in the same language. "Automatic Creation of Literature Abstracts"[2] describes some IBM research using the computer to analyze the different sentences of technical papers to locate the sentences which conveyed the maximum information about each paper. An advantage of this system is the elimination of bias of the human abstractor.

Electronics helps to find buried information

The next level of ML is that of machine retrieval (MR). Within this sub-class, information is documented and stored in the machine system. Later, when desired, the file of stored information is searched in order to retrieve specific information. Much work is being done in this field. The Patent Office, together with the National Bureau of Standards, has been developing methods for the automatic searching of chemical patent disclosures.[3] This technique can get extremely complex, as indicated by the report. The American Chemical Society has sponsored symposia on chemical information retrieval.[4] Western Reserve University has established a center on information retrieval and has published proceedings of symposia on the subject.[5] And the Monsanto Chemical Company has stored laboratory notes in a computer system, so that they may be retrieved and reports automatically prepared.[6]

Russian is being translated

Perhaps the most intriguing sub-class of ML is that of machine translation (MT). It is within this field that most of the RAND remarks were made. As might be suspected, much of the research in the United States centers around the automatic translation of Russian technical literature to English. At present, all known projects are at the research stage; none is producing translations on a production basis. Present methods and present machines are relatively inefficient in the translation; skilled human translators are much faster. A brief description of the steps which RAND found were involved in building a glossary might illustrate why.

First, several pages of text (called the "corpus") are photographed and enlarged 1-1/2 times (for ease of reading by key punch operators), edited to help guide the key punch personnel, then key punched--one line of text per card--and then verified. This is a slow, expensive process which automatic character recognition will aid (discussed later). But the key punch is a standard IBM key punch with the Russian letters pasted over the English letters, and with the layout of the Russian key board. Since the words are to be sorted alphabetically (in Russian), the computer must first translate the punched code into suitable code for sorting. At the same time, certain additional symbols are added to each word. The words of the corpus are then sorted alphabetically and summarized by the "form" of the word (each distinct spelling). These forms are to be printed out for human translators to review, so that they can add the equivalent English words plus grammar information. Note that the glossary must be developed before complete automatic translation can occur. However, the printer on the computer prints only English characters, not Russian, so the computer must convert the Russian letters to English letters which sound like the Russian letters. The printed words then do not look like Russian but phonetically they sound like Russian. The human translators then review the list and add one or more equivalent English words on the printed form, for each Russian word (one Russian word per line of printing). The form then goes to key punch where the words are key punched and verified. The punched cards are converted to tape, to form the glossary.

In Russian-to-English translation, the procedure is the same as for the glossary preparation up to the point where the corpus is sorted alphabetically. Then the sorted corpus is passed against the glossary, and the computer picks up the several English words. From the additional symbols tied to each Russian word, the computer can usually deduce which one English word is most suitable. Idioms obviously cause difficulty; also, prepositions are tough to handle, as a preposition can have up to 12 meanings and all have to be considered. The corpus then must be sorted back into the best English sequence.

Some of the grammatical problems of MT are discussed in "The Translating Machine: An ABC for You."[7]

As is obvious from the above discussion, one of the bottlenecks in MT is that of input--converting the printed pages of the corpus to

Character recognition is necessary

machine language. Automatic character recognition (or machine reading, one possible addition to ML sub-classes) thus will play an important part in practical MT, and in most other ML problems. Most of the development work in character recognition has been along the line of automatic reading of numbers--and primarily for bank checks.[8, 9, 10] There has also been some work done on handwritten numerals[11] and on the recognition of typed alphabetic information.

Other miscellaneous developments are being made in areas closely related to ML. In "Translingua: A World Language Based on Numbers,"[12] it is proposed that words and frequently-used phrases be given identical numbers in each language. This might be thought of as a master indexing project. It is claimed that messages could easily be compiled in one language and decoded in another. Another phase of MT is automatic computer programing which is reaching the point where computer programs may be written "in English" and translated automatically to computer language.[13]

Yes, the field of Machine Linguistics is developing rapidly.

REFERENCES

1. "705 Indexes Dead Sea Scrolls." Computing News, April 15, 1958 (DPD, May 1958 pg 3)

2. "Automatic Creation of Literature Abstracts," IBM Journal, April 1958 (DPD, June 1958, pg 1)

3. "A First Approach to Patent Searching Procedures in SEAC," Patent Office R & D Report #10 (DPD, May 1958, pg 13)

4. "Progress Report in Chemical Literature Retrieval," Interscience Publishers, 1957 (DPD, April 1958, pg 5)

5. "Information Systems in Documentation." Interscience Publishers, 1957 (DPD, February 1958, pg 4)

6. "Routine Report Writing by Computer," American Documentation, January 1958 (DPD, May 1958, pg 3)

7. "The Translating Machine: An ABC for You," Product Engineering, March 24, 1958 (DPD, May 1958, pg 11)

8. "Automatic Character Reading for Data Processing Systems," Public Administration Review, Summer 1957, (DPD, February 1958, pg 1)

9. "Automatic Handling of Checks," Banking, February 1958 (DPD, March 1958, pg 4)

10. "British 'ERA' Called Missing Link to Bank Automation," Journal of Machine Accounting, December 1957 (DPD, April 1958, pg 2)

11. "Reader Developed for Handwritten Numerals," Automatic Control, January 1958 (DPD, March 1958, pg 12)

12. "Translingua: A World Language Based on Numbers," Office, November 1957 (DPD, January 1958, pg 3)

13. "Computer Programs 'in English,'" Systems Magazine, September-October 1957 (DPD, January 1958, pg 9)

EDUCATION FOR EDP—A POSTSCRIPT

The Comment in May and June was devoted to a quick look at the state of secondary and college education in the field of EDP. We are happy to see a new section included in Communications of the ACM, beginning in the June issue, which gives news of educational activity by ACM, AIEE, and IRE members, and others in the computer industry, among high school age students. The section, called SENEWS is the newsletter of the Joint Computer Committee's Subcommittee on Science Education. Contributions are requested from anyone having an interesting item of information about EDP or computer education among high school age students. Write to: C. W. Farr, MIT Lincoln Laboratory, Lexington 73, Massachusetts.

Also, we have heard from Mr. Enoch Haga (from whose thesis we derived much information about EDP knowledge among secondary school educators) that his thesis is now filed with Sacramento State College, and that he has a few copies available. We will pass on to him any requests we receive for copies. Those persons he surveyed were business educators, in charge of all the state and large city business education programs in the United States. We did not make this clear in our June Comment.

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Training

Electronic Digital Computing and Applications--Advanced Programming Techniques
Date: August 18-22, 1958
Place: University of Houston
Fee: $100
Information: Computing and Data Processing Center
University of Houston, Houston 4, Texas

Intensive Courses in Industrial Engineering--Elements of Integrated and Automatic Data Processing
Date: September 8-19, 1958
Place: Washington University, St. Louis, Mo.
Fee: $450
Information: University College, Washington University,
St. Louis 5, Missouri

Installing Electronic Data Processing Systems
Date: October 13-17, 1958
Place: New York (Hotel Roosevelt)
Fee: $250
Information: Canning, Sisson and Associates, 1140 South Robertson Blvd.,
Los Angeles 35, California

COLLEGE COURSE

Sacramento State College, Sacramento, California, Fall 1958.
Introduction to EDP Systems
Machine Computation
Introduction to Linear Programming

Meetings

Technical Meeting on Automatic Decision-making, sponsored by Los Angeles Chapter of A. C. M.
Date: August 21, 1958
Place: University of California at Los Angeles

Power Industry Computer Application Conference
Date: September 15-17, 1958
Place: King Edward Hotel
Information: Mr. J. R. Leslie, c/o Ontario Hydro,
620 University Avenue, Toronto 2, Ontario, Canada

Instrument Society of America Automation Conference
Date: September 15-19, 1958
Place: Philadelphia, Pennsylvania (Convention Hall)

International Systems Meeting, Systems and Procedures Association
Date: October 13-15, 1958
Place: Pittsburgh, Pennsylvania (Hotel Penn-Sheraton)
Information: Mr. A. M. Motter, Jones & Laughlin Steel Corp., #3 Gateway Center, Pittsburgh 30, Pennsylvania

The Institute of Management Sciences Annual Meeting
Date: October 16, 18, 1958
Place: Philadelphia, Pennsylvania

Operations Research Society of America National Meeting
Date: October 23, 24, 1958
Place: St. Louis, Missouri (Statler Hotel)

Fifth Annual Computer Applications Symposium, Armour Research Foundation
Date: October 29, 30, 1958
Place: Chicago, Illinois
Information: Armour Research Foundation, 10 West 35th Street, Chicago 16, Illinois

Fourth Electronic Business Systems Conference, sponsored by Western Division of NMAA
Date: October 30, 31, 1958
Place: Seattle, Washington (Olympic Hotel)
Information: E. B. S. Conference, National Machine Accountants Assoc., Western Division, P. O. Box 134, Seattle 11, Washington

International Conference on Scientific Information
Date: November 16-21, 1958
Place: Washington, D. C. (Mayflower Hotel)
Information: Secretariate, International Conference on Scientific Information, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C.

National Physical Laboratory Symposium and Electronic Computer Exhibition
Date: November 28-December 4, 1958
Place: London, England
Information: C. V. Wattenbach, Deputy Managing Director, Dictograph Telephones, Ltd., London England

Eastern Joint Computer Conference
Date: December 1958
Place: Philadelphia, Pennsylvania (Bellevue Stratford Hotel)

References

The publishers of books and periodicals mentioned in this issue of DATA PROCESSING DIGEST are listed below for your convenience in writing for more complete information.

The Accountant
4 Drapers' Gardens
Throgmorton Avenue
London EC 2, England

American Documentation
(see Interscience Publishers)

Automatic Control
430 Park Avenue
New York 22, New York

Automation Progress
Stratford House
9 Eden Street
London NW 1, England

Banking
12 East 36th Street
New York 16, New York

Business Week
(see McGraw-Hill)

The Computer Journal
The British Computer Society Ltd.
Finsbury Court, Finsbury Pavement
London EC 2, England

Computing News
12805 - 64th Avenue South
Seattle 88, Washington

Contractors and Engineers
470 Fourth Avenue
New York 16, New York

DataMation
10373 West Pico Boulevard
Los Angeles 64, California

Harvard University Press
Cambridge 38, Massachusetts

IBM Journal
590 Madison Avenue
New York 22, New York

Internal Auditor
120 Wall Street
New York 5, New York

Interpreter
I.A.S.A.
P.O. Box 139
Kansas City, Missouri

Interscience Publishers
250 Fifth Avenue
New York 1, New York

Irwin, Inc.
1818 Ridge Rd.
Homewood, Illinois

Journal of Machine Accounting
208 South Main Street
Paris, Illinois

Macmillan Co.
60 Fifth Avenue
New York 11, New York

McGraw-Hill Book Co., Inc.
330 West 42nd Street
New York 36, New York

N.A.A. Bulletin
505 Park Avenue
New York 22, New York

Navy Management Review
Supt. of Documents
U.S. Government Printing Office
Washington 25, D. C.

The Office
232 Madison Avenue
New York 16, New York

Office Automation
Automation Consultants, Inc.
155 Fifth Avenue
New York 10, New York

Office Equipment News
146 Bates Road
Montreal 8, Canada

Penguin Books
3300 Clipper Mill Road
Baltimore, Maryland

Prentice-Hall, Inc.
Englewood Cliffs, New Jersey

Product Engineering
(see McGraw-Hill)

Public Administration Review
6042 Kimbark Avenue
Chicago 37, Illinois

Stanford University Press
Stanford, California

Systems Magazine
315 Fourth Avenue
New York 10, New York

Western Electronic News
328 North LaBrea
Los Angeles 36, California

John Wiley & Sons, Inc.
440 Fourth Avenue
New York 16, New York